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# A COAL-MEASURE FOREST NEAR SOCORRO, NEW MEXICO.

WE have grown so accustomed to consider that in the Rocky Mountain region the period represented in the eastern states by the deposition of coal was inimical to terrestrial life, or otherwise so different from the corresponding eastern time in its conditions that it is useless to search for a coal flora, that considerable interest attaches to any area, however restricted, in which a genuine Coal-Measure flora is present.

Such an area became known to the writer a number of years ago, but it long proved impossible to study the locality in person. A small suite of fossils reported to have been collected in the fire-clay beds east of Socorro was placed in the writer's hands by Mr. George Thwaites, and, after several fruitless attempts to identify the locality, the occurrence was reported, and, later, figures were given of four species of lepidodendrids which could be distinguished as distinct. There figures occur on Plate VII of the *Bulletin of the University of New Mexico* for 1900. No descriptions were given, and considerable uncertainty still existed as to the age of the formation from which they were derived.

More recently the writer has not only been able to locate the place and add to the original collection of specimens, but he has carried out a considerable amount of field work in the immediate locality which will suffice to settle the principal questions of stratigraphy so long left open.

Whenever the nature of the contact between the granite and the superjacent rocks shall be studied carefully throughout the territory, many interesting points will be brought out. Whether the granite itself is a homogeneous element or represents various periods must be left an open question. We have every reason to conclude that it represents the metamorphosed sediments of an early geological time, and the writer has already reported instances where limestone beds within the granite have been found to contain what greatly resemble altered organic remains. It is also known that the granites, in common with the immediately overlying strata, have suffered great erosion in the early part of the so-called Permian. This period of elevation, disturbance, and oscillation does not, however, seem to mark any great lost interval, so far as the record shows, while the interval represented by the granite contact is undoubtedly a considerable and variable one. The disturbance which lifted the granites above the reach of the sea may not have been very extreme, and it is not likely that the present extreme of metamorphism was reached till long after, though it was certainly before the time in which the breccias and sandy beds of the Permian were formed, for these strata contain granite fragments in abundance.

At any rate, when the sea began to return by subsidence of the granite, this encroachment was gradual, and from the south toward the north and northwest. This is proved by the fact that the exposures in the southeastern counties reveal vast deposits between the granite and the Carboniferous in which we have identified strata as old as the Burlington, superposed upon others yet older, but not identified as yet. In the southwestern part of New Mexico there are still earlier strata, some of which have been referred to the Devonian (*Hamilton*). The writer hopes to enter upon this subject more in detail in another place; at present it will be sufficient to indicate that as far north as in Socorro county the stratified rocks overlying the granite have revealed no remains indicating an age earlier than the Carboniferous, and the writer knows of no positive datum representing anything older than the Coal Measures. It is true that there are reports of Subcarboniferous crinoids from the Graphic-Kelly beds lying upon the crystallines near Magdalena, but inasmuch as this 100 feet or more of crystalline limestone, which is so interestingly developed in the lead district, is not found in the locality under discussion east of the Rio Grande, nor yet farther north in the Rio Grande valley, it may be said roughly that the boundary between the lower formations and the Coal Measures passes through Socorro county.

Corresponding to the change just described is a still more pronounced geographical change in the character of the Permian and "red bed" deposits, which have an entirely different facies and succession in the northwestern counties from the typical Texas sequence exhibited in the southeast.

The writer has described the Rio Grande valley as a region of early uplift—in effect an anticline, though the anticlinal axis is not exposed to view—and accordingly the dip of the strata is prevailingly to the west on the west side and to the east on the eastern side of the valley. The granite core of this anticline is largely removed, but is exposed in the bases of the Sandia, Manzana, San Andres, and Organ mountain ranges on the east side of the valley, as well as in the core of the great Sierra Ladrone uplift and the base of the Limitar Mountain on the west.

The interval between these remaining buttresses of the great eroded mass is now, for the most part, filled with late strata composed of Tertiary (Santa Fé marls) and Pleistocene deposits, mostly nearly horizontal, except in proximity to the areas of late volcanic disturbance. There are also perforating necks and cones of basalt, as well as interstrata flows and dikes of the same material, but of an older period.

In the *American Geologist* of recent date[1] the writer announced the discovery of granite masses in the valley in the midst of the Tertiary beds, and gave a section extending from the Rio Grande east of Socorro through these granitic bosses. This section is so taken as to pass through the region here under discussion, though it does not cut the exact locality in which the fossil coal flora was found.

These granite ribs (Fig. 1) are two in number, and are separated by an interval of perhaps half a mile, which is partly covered by the Tertiary beds, but, wherever cut by arroyos or canyons, the lower or Sandia formation of the Coal Measures is exposed in basin-like relation upon the granite, forming a shallow syncline (really a modified monocline). The western rib or elongated boss of granite rises not over 100 feet above the canyon level, and presents a sharp slickensided fault to the west, with a course some twelve degrees east of north where measured. In some places the Tertiary wholly covers the boss, and to the north and south the granite passes out of sight beneath this formation, the entire length being perhaps two miles, as exposed. The eastern exposure presents the overlying but unconformable Coal-Measure formation consisting of shales, silicious shale, quartzite, and ferruginous conglomerate near the contact, followed by a large series (over 200 feet) of alternating shales, quartzites, and earthy or sandy limestones, the latter being quite fossiliferous.

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[1] "Laws of Formation of New Mexico Mountain Ranges," May, 1904.

Of the Graphic-Kelly formation which in the Magdalena Mountains, a few miles to the west, separates the Sandia series from the granite, there is no trace.

The Coal-Measure rocks soon become horizontal, and at the eastern side of the basin, where they abut upon the eastern boss or rib of granite, they dip to the west and lie in juxtaposition to a fault exactly similar to that on the western side of the first-mentioned or western rib. In fact, the eastern rib is to all intents a repetition of the first, and the Sandia series is repeated on the eastern aspect in all essential respects as it occurs to the east of the western granite rib.

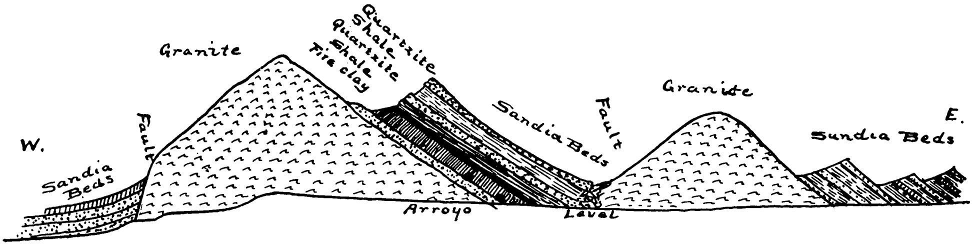

FIG. 1.

Locally, however, there is a third fault which serves to repeat the granite. This fault is a few hundred yards east of fault No. 2, and in the interval there are preserved a few of the Sandia strata, though in many places they are entirely removed by erosion. It is in the V formed by these two faults that the best example occurs of the fire-clay beds with the inclosed plant remains. In other localities the fire clay also occurs beyond the influence of this local fault, but these points are as yet little explored, and, in several localities visited, the granite contact has only a silicious shale in the place of the fire clay.

The dip of the strata as they repose on the granite may be as high as 70 degrees, but more often about 45 degrees. Passing eastward, one crosses in succession a number of low hills, each capped by a bed of quartzite, the intervals being filled with shale and limestone, the superior resistance of the quartzites having thus impressed itself upon the topography. When the top of the Sandia formation is reached, the topography changes, and the country rises in abrupt escarpments of massive to earthy limestone of the characteristic Upper Coal-Measure habitus. At the base, this formation is locally very fossiliferous with the well-known Coal-Measure assemblage, a partial list of which will be given below.

The first escarpment may rise some 100 to 150 feet, and is followed by others of the same character, indicating a probable aggregate thickness of 300 to 500 feet. The continuity of the section is here broken by what may be called the "Cane Spring monocline" or fault zone. This will be more particularly described later on, and it will here be noted that this break forms in effect a rough delimitation of the Carboniferous from the so-called Permian. To the east of this the hills are mostly composed of earthy limestones, with shales of prevailingly reddish color, with gypsum beds and calcium anhydrite deposits to the base of the great escarpment forming the sky-line to the spectator from the west side of the river at Socorro. This ridge, which is the southern continuation of the Cibolo (Seboyo) Mountains, consists of from 500 to 600 feet of red beds, with gypsum and anhydrite inclusions, capped by 150 to 175 feet of yellowish sandstone and 100 to 200 feet of gray, massive, non-fossiliferous limestone, with at least one small band of quartzite. Still to the eastward are hills containing the typical upper red-bed formations. To the south this whole series disappears beneath the Carthage coal fields of Cretaceous age.

To return to the plant beds, it will be noted that the fire clay, with its attendant shales, reposes directly upon the granite, or with a thin layer of quartzite between. The clay is of good quality, but very irregular, and has formed the base of the fire brick manufactured by the Socorro Fire Clay Co. In the clay, and especially in the shales overlying, are the remains of lepidodendrids and other coal plants referred to. A thin seam of coal is apparently present, though at the time of our inspection there was no opportunity to discover it in place. Report affirms that a boring one and one-half miles south encountered two small coal seams within 200 feet.

The thickness of the clay and attendant shales is not over 30 feet, of which half may be roughly estimated as clay. Then follows 10 feet of silicious shale capped with quartzite, and 15 feet of similar shales also capped with about 5 feet of quartzite. This is all that remains of the great Sandia beds at this place, but to the east, on the other side of the third granite mass, the series is complete. This occurrence may be termed the "Incarnacion" fire clay, and the same name will apply to the granite exposure, it being the name of the mining district in which these exposures occur.

There would seem to be no reason for separating the fire clay from the Sandia formation, it being but a local variation, and, even where the clay is not found, obscure plant remains attest the similarity of conditions to some extent.[1]

*The Cane Spring fault area.*—In this connection it may be desirable to call attention to this profound dislocation, the exact nature of which varies from point to point, but which is apparently found at a distance of a mile or more to the west of the main escarpment of the Cibola ridge. It lies nearly midway between the Incarnacion granite ribs, with their faults, and the main range just mentioned. The typical exposure is, however, at "Ojo de las cañas," or Cane Spring, a permanent water in the large arroyo joining the Rio Grande immediately south of Socorro and owing its existence to the faulted area. A section extending from the fault to the Cibola ridge is given, the data being approximate, but sufficient to give some idea of the conditions.

The disturbance is profound and has the appearance of being a double anticline with an interval separating the two members of some eighth of a mile. At Cane Spring, where the disturbance is most easily seen, about 700 feet of red, green, and yellow sandstone, shale, and marl are tilted up at a high angle, with the appearance of an appressed fold, the dip being to the west on the west side and to the east on the opposite side of the axis. The western limb is concealed by a covering of Tertiary, but on the east is a sharp fault, against which the nearly horizontal strata abut with little inclination. Thence eastward there are exposed by the arroyo about 100 feet of red and yellow sand and marl to the second break, which is very similar to the one just described. The section figured (Fig. 2) is a mile or more north of the spring, but has a similar double character. It is impossible to be certain that the disturbance is due to a double appressed fold separated by faults, but such is the appearance. At this locality the western side of the break is also exposed, and is a distinct fault, with much alteration and excretion of quartz. A curious quartz breccia is a feature of the fault on the western side. The upper Coal Measures or Permo-Carboniferous appears on the west, and about half a mile west of the fault we found fossils including *Phillipsia major* and other types known to be well up in the series.

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[1] Since writing the above, similar plant remains (*Lepidodendron* sp., same as Fig. 9 below) have been found in the lower part of the Sandia series on the west side of the Ladrones Mountains, where the Sandia quartzite reposes directly upon the metamorphic rocks (schists and granites).

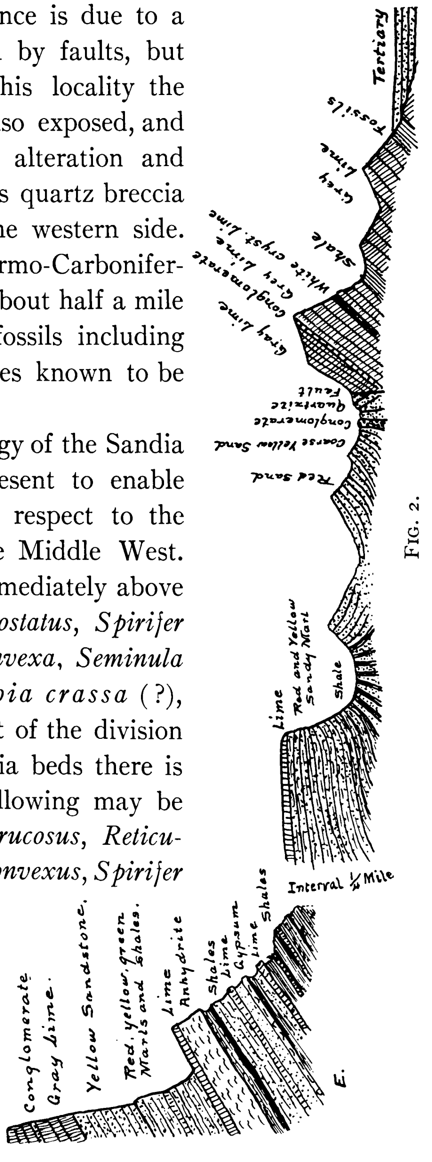

FIG. 2.

Unfortunately, the paleontology of the Sandia series is too little known at present to enable us to locate it definitely with respect to the divisions now recognized in the Middle West. We have determined in it, immediately above the fire clay beds, *Productus costatus*, *Spirifer cameratus*, *Ambocoelia planoconvexa*, *Seminula argentea* (small form), *Derbia crassa* (?), bryozoa, etc. In the lower part of the division immediately following the Sandia beds there is a large fauna, of which the following may be mentioned: *Eupachycrinus verrucosus*, *Reticularia lineatus*, *Ambocoelia planoconvexus*, *Spirifer striatus*, *Spirifer cameratus*, *Productus cora*, *Productus nebracensis*, *P. semireticulatus*, *Seminula argentea* (large form), *Derbia crassa*, *Chonetes granulifera*, *Dielasma bovidens* (rare at this horizon, abundant higher up), *Streblopteria* (?). It may be noted that *Eupachycrinus* is known in the Kansas section from the Earlton to the Severly, *Chonetes granulifera* commences in the

Leucompton beds and extends upward, *Streblopteria* begins in the Earlton. So far as can be determined at this writing, the position is near the horizon indicated by Iola limestone, or within the Pottawatomie formation of Haworth. This is above the base of the Upper Coal Measures.

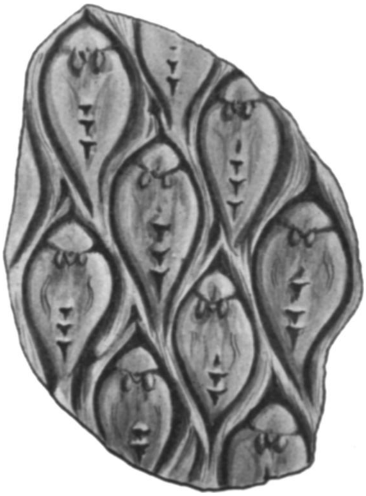

FIG. 3.—*Lepidodendron thwaitesi*, sp. n. (One-half natural size.)

Below are given in tabulated form, for comparison, some of the more complete sections across the Permo-Carboniferous. It will be found that there is always a well-marked change in lithological character of the rock at the horizon of the Manzano quartzite. Here is evidence of an unconformity by overlap. The lime breccias or small strata of lime with angular fragments of earlier lime and granite are quite characteristic of this general belt, and the Manzano beds themselves usually contain vast quantities of red granitic débris. Often vein quartz is present, and it is also common to find impressions of tree trunks. All of these phenomena indicate proximity of land and a period of disturbance. The Sandia formation is easily distinguished, but it is more difficult to decide upon divisions of the Upper Coal Measures above that section. In general, there is a change of fauna, though numerous species pass unchanged throughout. *Productus punctatus*, *Dielasma bovidens*, and *Meekelia* are characteristic of the upper portions. The large *Fusulina* is found at a higher level than the common *F. cylindrica*.

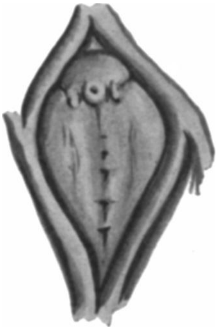

FIG. 4.—*Lepidodendron thwaitesi*, sp. n. (Single bolster, enlarged.)

### SECTION EAST OF SOCORRO.

| | |
|---|---|
| Gray lime | 25–50 ft. |
| Red quartzite | 10 |
| Gray lime | 65 |
| Whitish to yellow sandstone | 150 |
| Red marly beds with lime, etc. | 100–150 |
| Earthy lime | 10 |
| Anhydrite | 50–75 ft. |
| Sandy shales, shales, and lime | 100 |
| Gypsum | 5 |
| Sandy shales, marls, and lime | Indef. |
| Red beds, as above | Indef. |
| Lime (hard greenish, earthy) | 10 |
| Yellow sandstone | 20 |
| Red sandstone | 30 |
| Silicious shales | |
| Alternating shales (quartzites, green limestone, red flags) | 300–500 |
| Red granitic conglomerate quartzite. | |
| Massive limestone (fossiliferous) | 25 |
| Manzano (massive) quartzite | 40–50 |
| Lime breccia. | |

*Top of Upper Carboniferous formation* (*c* 130).

| | |
|---|---|
| Massive limestones, shales | 60–75 ft. |
| Calcareous conglomerate | 5 |
| Limestone | 50 |
| Sandy conglomerate (*b*, 147) | 5 |
| Limestone | 5 |
| Silicious shale | 2 |
| Earthy limestone | 35 |
| Massive and shaly lime | 100 |
| Yellow sandstone (*a*, 66 ft.) | 15–20 |
| Shaly lime | 6 |
| Massive lime | 3 |
| Shaly lime | 8 |
| Massive lime | 4 ft. |
| Shaly lime | 6 |
| Massive lime | 4 |
| Shales and shaly lime | 15 |

*Top Sandia formation* (235 ft.).

| | |
|---|---|
| Red quartzite | 4 |
| Red shale | 10 |
| Quartzite | 6 |
| Shale | 10 |
| Sandy lime (fossiliferous) | 6 |
| Quartzite | 8 |
| Shale | 10 |
| Limestone (fossilferous) | 3 |
| Shale | 6 |
| Limestone | 4 |
| Shale | 6 |
| Quartzite | 4 |
| Shale | |
| Limestone | 4 |
| Shale | 6 |
| Red coarse sandstone | 20 |
| Green fissile shale | 25 |
| Earthy limestone | 5 |
| Sandy shales and quartzite | 50 |
| Coarse quartzite | 8 |
| Clay and shale (Lepidodendrids) | 35 |
| Contact quartzite | Indef. |
| Granite. | |

### SECTION NEAR COYOTE SPRINGS, SOUTH-EAST OF ALBUQUERQUE.

(Permian not exposed; see below.)

| | |
|---|---|
| Massive limestone | 10 ft. |
| Nodular limestone | 3 |
| Massive limestone | 4 |
| Shaly limestone | 28 |
| Granular limestone | 3 |
| Micaceous shales. | |
| Coyote yellow sandstone (*b*) | 2–30 |
| Massive limestone | 85 |
| Fusulina limestone | 23 |
| Shale (bryozoa) | 2 |

| | |
|---|---|
| Massive limestone | 48 ft. |
| Shaly limestone | 47 |
| Massive limestone | 15 |
| Shales (Flint Ridge beds) | 33 |
| Green quartzite | 2 |
| Massive limestone (productus) | 12 |
| Nodular shaly lime | 2 |
| Massive limestone | 30 |
| Black shaly lime | 48 |
| Massive lime | 3 |
| Lime and lime shales | 40 |
| Sandstone (*a*) | 2–4 |
| Sandy lime | 17 ft. |
| Massive limestone and Sandy shaly lime | 28 |
| Fusulina cylindrica beds | |
| Shales | 28 |
| *Top of Sandia formation* (119 ft.). | |
| Sandy shale, with bands of limestone, alternating with quartzite | 45 |
| Silicious fossil lime | 2 |
| Sand and shales | 22 |
| Basal quartzite | 50 |
| Granite or gneiss. | |

Near the locality in which the Coyote section was measured a section was taken which is more complete toward the top and serves to supplement the above section. That part of it above the Coyote sandstone horizon is here given:

| | |
|---|---|
| Manzano quartzite, red and yellow granitic sand, and conglomerate with silicified wood and granitic pebbles | 55 ft. |
| *Top of Upper Carboniferous.* | |
| Earthy lime with lime breccia, etc. | 50 |
| Earthy lime with green bands (bryozoa) | 25 |
| Earthy cherty lime (*Productus punctatus*) | 16 |
| Massive lime (*Productus cora*) | 25 |
| Black shaly lime (*Dielasma bovidens*) | 17 |
| Bryozoa beds. | |
| Gray lime (*Fusulina robusta?*) | 6 |
| Massive lime | 22 |
| Coyote sandstone horizon. | |

Below this point the section corresponds essentially with the section given above. This corresponds to a total thickness of the Coal Measures of 750 feet, of which about 130 feet is formed by the Sandia beds. The section east of Socorro contains about 600 feet, of which 235 feet is contributed by the Sandia beds.

In order to indicate the amount of variation in the same region, a section is here given corresponding with that last above recorded and taken only a short distance east of it in the Coyote district:

| | |
|---|---|
| Massive earthy lime with *Bellerophon*, *Productus punctatus*, etc. | 72 ft. |
| *Allorisma* and numerous fossils. | |
| Sandstone | 40 |

| | |
|---|---|
| Earthy fossiliferous lime | 17 ft. |
| Sandy shale and granular lime | 5 |
| Earthy limestone (*Dielasma bovidens*, *Discina*, etc.) | 11 |
| Calcareous sandstone | 14 |
| Green sandy shale | 6 |
| Reddish yellow sandstone (Coyote) | 40 |
| Massive earthy lime. | |

It appears that this last section falls a little short of reaching the Manzano quartzite and develops a great deal more of the sandy materials that are found farther west, though the Coyote sandstone has been observed to be 40 feet thick in one place, and entirely absent or reduced to a few inches within the distance of half a mile in continuous exposure.

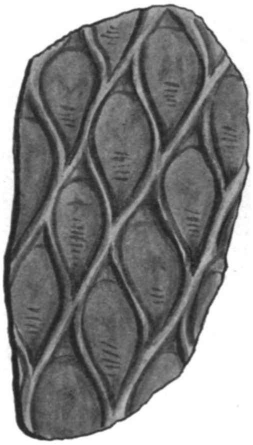

FIG. 5.—*Lepidodendron thwaitesi*, var. *striolatum*, var. n. (One-half natural size.)

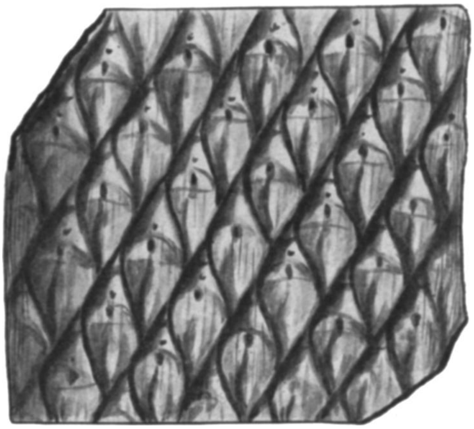

FIG. 6.—*Lepidodendron socorroense*, sp. n. (One-half natural size.)

For comparison, the following incomplete section may be given from the escarpment west of the Rio Grande in about Township 5 N., Range 4 W., of New Mexico P. M. This locality is northwest of the Ladrones Mountains.

| | |
|---|---|
| Lava flow (basalt). | |
| Red flags and shales (position uncertain) | 200-300 ft. |
| *Fault.* | |
| Limestone with (Permian ?) fossils | 15 |

| | |
|---|---|
| Limestone and shale | 90 ft. |
| Sandstone shale with lime bands | 10 |
| Gray limestone | 100 |
| White sandstone | 40 |
| Gray (gypsiferous) shales | 20 |
| Yellowish sandstone | 100 |
| Yellowish shale | 5 |
| Reddish gypsiferous shale | 175 |
| Anhydrite and limestone resting on fissile shale | 100 |
| Gray shales | Unexposed. |

Red flags and shales (several hundred feet).

Carboniferous limestone (Coal Measures). At least 400 ft.

The Carboniferous is separated from the detailed section by a valley perhaps a mile wide filled with low hills of the red beds, the dip being in all cases to the east. It is therefore very difficult to determine the thickness of the red beds, nor is it certain that there is no dislocation. There is the same difficulty in determining the extent of the fault at the top of the detailed section, but it is presumed that the throw is small, though there is an area of vertical strata intervening.

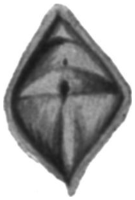

FIG. 7.—*Lepidodendron socorroense.* (Enlarged bolster of different form.)

It is not difficult to conclude that the detailed section here given corresponds in a general way with that east of Socorro above the sandy shales, etc., marked as "indefinite." In fact, it would appear that the thick anhydrite bed is a very convenient and rather constant bench mark, however variable it may be in thickness.

References may here be made to the section given in the writer's article on the "White Sands."[1] This section is from a locality comparatively rich in fossils of a decidedly Permian habitus.

### PLANTS OF THE INCARNACION CLAYS.

The following descriptions are given as a matter of convenience, in spite of the fact that it has not been possible to compare our specimens with eastern types. The forms seem to be new, and may serve to assist in calling attention to similar occurrences in the Southwest.

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[1] *Bulletin of the University of New Mexico,* Vol. II, Fasc. 3, p. 10.

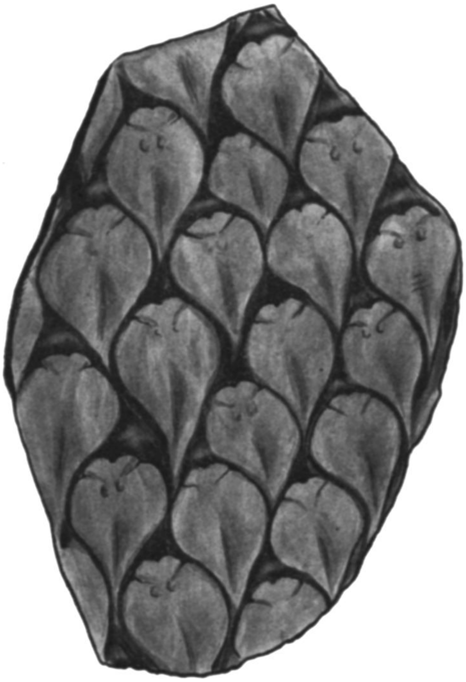

FIG. 8.

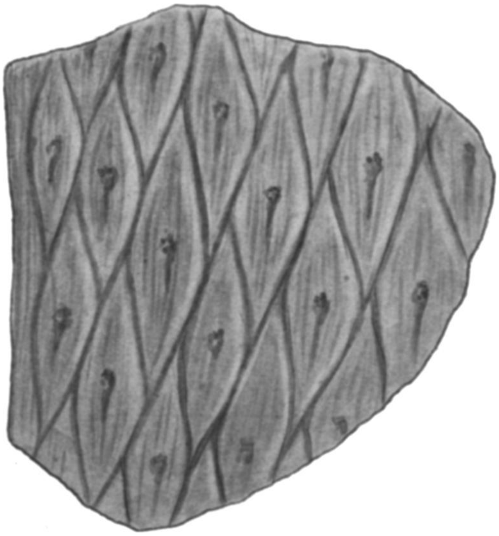

FIG. 9.

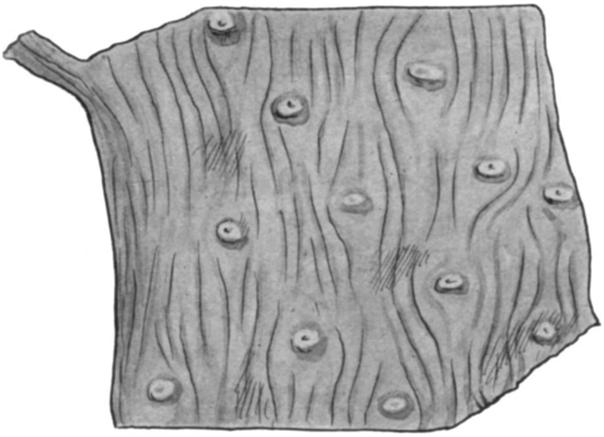

FIG. 10.

FIG. 8.—*Lepidodendron keyesi*, sp. n. (One-half natural size.)

FIG. 9.—*Lepidodendron* sp. ? (One-half natural size.)

FIG. 10.—"*Stigmaria.*" Root of one of the above?

### *Lepidodendron thwaitesi*, sp. n. (Figs. 3 and 4.)

(*Cf. Bulletin of the University of New Mexico*, Vol. II, Plate VII, Figs. 2 and (?) 4.)

Trunks of large size. Bolster somewhat oval, kite-shaped to rhomboidal, about two and one-half times as long as wide, rather thickly set, but separated by high striated ridges; length of bolster, 0.9 in.; width, 0.4 in.; 1.2 in., and 0.45 in., 1.3 in. and 0.5 in., in three cases; seven bolsters in the space of 4.5 in., measured obliquely along the rows in branch over 6 in. in diameter, seven in 5 in. in a larger specimen. Leaf scars (cicatrix) small, transversely oval, about one-fourth as long as entire bolster. Middle of bolster below the cicatrix marked with a ridge or depressed cauda, crossed by three very distinct frets. Transpiring vents well marked on either side below the cicatrix, with which they are connected; vascular trace punctiform, often absent. Ligular scar near apex of cicatrix, triangular, often apparently notching apex of cicatrix. An escutcheon-like impression between transpiratory vents. Leaves sharply acuminate with slender tips, midrib strong, 3 in. wide and perhaps 8 in. long.

### *Lepidodendron thwaitesi*, var. *striolatum*, var. n. (Fig. 5.)

Greatly resembling L. thwaitesi, and perhaps a variety of that species, but represented by smaller specimens in which the preservation is not very perfect.

Bolsters uniformly rhomboidal oval, surface flat, about five in the space of 2.4 in. measured diagonally in the rows. Length, 0.72 in., width, 0.35 in. Space below the cicatrix marked with numerous (5–7) irregular frets. Cicatrix apparently as in *L. thwaitesi.*

### *Lepidodendron socorroense*, sp. n. (Figs. 6 and 7.)

(*Bulletin of the University of New Mexico*, Vol. II, Plate VII, Fig. 1 ?)

Trunks of moderate size, leaves slender. Bolsters rhomboidal to rhombic oval, acuminate at the ends, nearly symmetrical; lower portion, from the leaf scar downward, kite-shaped to rhomboidal, upper margin curved, the long axis marked by a well-defined keel, very prominent near the lower angle, where is an elevation; folar cicatrix about one-fourth the entire length of bolster; transpiratory appendages obscure; vascular pore on the most prominent part of cicatrix; a deep pit below the cicatrix on median line; ligule large, well marked. Bolsters closely approximate, in well-defined oblique series; 0.7 in. long, 0.3 in. wide. In a trunk 3.2 in. in diameter 9 bolsters in space of 3.5 in., measured diagonally in the rows; in larger trunks 9 bolsters in 4.3 in.

This species is well represented, and is variable in size, but the specimens leave much to be desired in detailed structure of the leaf scars.

### *Lepidodendron keyesi*, sp. n. (Fig. 8.)

Trunk of large size. Bolsters large, obovate, flat, closely approximate, in well-defined diagonal rows. Eight bolsters in space of 4 in., measured obliquely in the rows. Length of bolster, 0.75-0.8 in.; width, 0.5 in. Cicatrix nearly reaching middle of length of bolster; ligule very large, often causing the upper part of cicatrix to appear emarginate. Transpiratory appendages large, oval, discrete. A groove extends from cicatrix to the lower angle of the bolster, and there are traces of frets. State of preservation imperfect. Named in honor of Dr. Charles R. Keyes, of the New Mexico School of Mines.

### *Lepidodendron*, sp. ?. (Fig. 9.)

(*Bulletin of the University of New Mexico*, Vol. II, Plate VII, Fig. 3.)

In form of bolsters this form is like *L. brittsi* or *L. aculeatum*.

All our specimens seem to be decorticated, so that it seems unsafe to attempt a description. It is even possible that these specimens belong to one of the above species, although in appearance they differ widely.

There are five bolsters in a space of 3.7 in., measured diagonally in the rows. Length of bolster, 1.6 in.; width, 0.4 in. Vascular scar above the middle. Surface of (decorticated) specimen striolate.

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